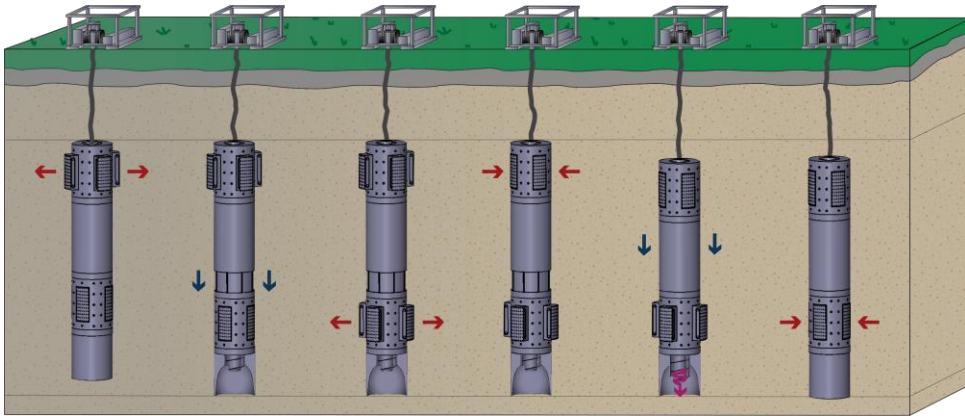


Licensing Opportunity

Self-burrowing probe for *in-situ* soil investigation



Underground penetration sequence of the self-burrowing probe (left, not to scale); and prototype of the radial anchor unit (right).

Application

This subsurface drilling device reduces the cost of onshore and offshore geotechnical testing. It requires neither a drilling rig nor a specialized operating vessel. Its autonomous operation lends itself to multi-site testing, thus, contributing to a comprehensive geotechnical dataset for soil assessment.

Features & Benefits

- Autonomous underground penetration
- Small footprint for operating close to existing structures
- Simultaneous soil penetration and testing
- Modular design for anchoring, propulsion & excavation

Publication

- “Novel self-burrowing probe for in-situ soil investigation: development and testing in a calibration chamber”, PhD thesis, <https://doi.org/10.3929/ethz-c-000791266>
- Patent pending, [WO/2025/098863](https://patents.google.com/patent/WO/2025/098863)

Background

The evaluation of soil properties is a crucial task in geotechnical engineering. Field-testing requires a probe with sufficient instrumentation, which in turn must be driven into the soil to a certain depth. The deployment of the machinery required to perform soil penetration, offshore or close to existing structures, is expensive and time-consuming. Furthermore, in-situ tests provide only limited local data, which cannot be generalized for the entire geotechnical site due to the spatial variability of soil characteristics. Cost and time often prohibit multi-site testing, which forces practitioners to interpolate values of geotechnical parameters between sparse testing points, increasing the uncertainty in geotechnical design.

Invention

The probe comprises two radial anchor systems with an axial propulsion system. The rear anchor system expands to secure the probe in the cavity, allowing the axial propulsion system to drive its front segment downwards. Subsequently, the front anchor system is engaged and the rear one retracts, while the propulsion system pulls the rear segment downwards. Once the front anchors are retracted, a full locomotion cycle is completed (see figure above). To minimize soil disturbance and tip resistance during penetration, the probe is equipped with a rotating drill and an internal auger. Although the developed probe is autonomous, a small frame unit on the ground or seabed surface is needed to position the probe vertically and provide an initial reaction force. The probe uses the force-displacement response of the axial push of the propulsion system and the radial expansion of the anchors to directly measure soil stress-strain response and infer the soil properties. A prototype has been built and successfully tested using Perth sand in a laboratory calibration chamber.



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 Reference 2022-160

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Technology Readiness Level

